Project Title: Metrics for Nitrate Contamination of Ground Water at CAFO Land Application Sites (GWERD/EPA Region 6 RARE Project DW12921711)

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Project Period: 08/09/2003 - 09/30/2006

Long-Term Goal/APM: This is a Regional Applied Research Effort (RARE) project with EPA Region 6. Research addresses WQ MYP LTG3/APG 58. Specific APMs will be developed for this project.

Abstract: Recent research by EPA in Oklahoma has demonstrated that land application of CAFO waste can cause nitrate contamination of ground water above MCLs at significant depths (> 30 ft). This finding and similar ones across the nation are raising concerns about the potential for CAFO waste land application to degrade ground water quality under and near these sites. As a rule, land application of CAFO waste is required to follow a Comprehensive Nutrient Management Plan (CNMP). A CNMP is a design document which sets rates for waste application to meet the water and nutrient requirements of the selected crops for the soil types present. CNMPs are developed to adhere to state-specific National Resources Conservation Service (NRCS) guidelines which are typically written to be protective of surface water resources. A tacit assumption is that a well designed and executed CNMP ensures that all nutrients are taken up in the root zone so that ground water is inherently protected. EPA is partnering with the Agricultural Research Service (ARS) through an IAG to undertake this research to assess if CNMPs when properly executed are consistently protective of ground water and if not, what soil/crop metrics and operations guidance can be developed to ensure they are. The study focuses on the identification of soil/crop conditions and land application practices which allow nitrate, ammonia and phosphate in land applied CAFO effluent to move beyond the rooting depth of plants even when applications are made in accordance with a properly designed and executed CNMP. The study involves the comprehensive sampling of the soils, soil water and crops for nitrate, ammonia and phosphate on several plots in the land application area of an existing CAFO site. The nutrient values in these samples are being compared to the timing and volume of land application effluent, irrigation and precipitation to discern relationships between land application practices and nutrients entering and escaping the root zone. The study will take place over at least one entire year to capture seasonal effects, with bimonthly sampling. Based on the results, EPA and ARS will determine which simple soil/crop metrics are the best indicators of the potential for nutrients to escape the root zone and become a threat to ground water. EPA and ARS will also identify which land application practices are most likely to allow nutrients to escape the root zone (timing, volume, crop condition, etc).

Status: In the Summer 2004, a dairy CAFO site which had been in operation for ten years was selected. Four 10 m square sample plots were created in two separate locations and instrumented with lysimeters. Soil cores have been taken two weeks before the yearly waste application and seven times since. Initial results show very high soil nitrates in the cores which vary with depth (100 mg/kg at surface, 30 mg/kg at 0.5m and 50 mg/kg at 1.0 m). Lysimeter water values are also very high (up to 500 mg/l nitrate). Plant tissue values are being evaluated. Additional RARE funding has since been obtained to select and evaluate another CAFO in a different geological setting.

Products: The main product of this research will be a practical guidance document which may be used by ARS and NRCS to inform CAFO waste land application site operators on which metrics should be monitored to verify that a rigorously followed CNMP is protective of ground water. This guidance will include which parameters (soil nitrate, root depth, waste ammonia, phosphate, etc) are the best indicators of potential contamination of ground water, the most practical field methods for their measurement, and how to monitor/adjust land application management practices to maintain these parameters within safe ranges which are protective of ground water. While specifically designed for CAFO investigations, the general guidelines would be applicable for most sites where nitrate and phosphate infiltration to ground water is a concern. The results of this project will be disseminated through the EPA/NRCS Land Application Water Quality Task Team, through publication in a technical journal, and through results posted on EPA, NRCS, and ARS web sites.